2.2 Movement Analysis: Lever Systems in Sport: 10-minute Pack

AQA 8582 · Calculator allowed · about 10 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Which of the following best describes a lever?

- ☐ A) A rigid rod that rotates about a fixed point when a force is applied to it
- ☐ B) A muscle that shortens to pull on a bone
- ☐ C) The total range of movement possible at a joint
- ☐ D) A type of joint found in the shoulder and hip

(Total for Question 1 is 1 mark)

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2 A swimmer pushes off the pool wall, extending both elbows to drive their arms out ahead of them into a streamlined position.

- ☐ A) First class lever
- ☐ B) Second class lever
- ☐ C) Third class lever
- ☐ D) Fourth class lever

(Total for Question 2 is 1 mark)

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3 A fast bowler's forearm acts as a first class lever as the elbow extends explosively during the delivery action, with the triceps acting close to the elbow joint. In a simplified model of this action, the effort arm (elbow to triceps insertion) measures 3 cm and the load arm (elbow to the ball in the hand) measures 33 cm.

(a) Calculate the mechanical advantage of this lever. **(2)**

(b) State whether this represents a mechanical advantage or a mechanical disadvantage, and explain your answer. **(2)**

(c) Explain why this large mechanical disadvantage is actually beneficial to a fast bowler. **(2)**

(Total for Question 3 is 6 marks)

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4 A footballer swings their leg forward and extends the knee sharply, using the quadriceps, to strike a ball during a shot at goal. Identify the class of lever used and justify your answer.

(Total for Question 4 is 2 marks)

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5 Explain one limitation of the human body having mostly third class levers when it comes to lifting or moving very heavy loads.

(Total for Question 5 is 2 marks)

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Mark scheme · 2.2 Movement Analysis: Lever Systems in Sport: 10-minute Pack

Question 1

A **B1**

Answer: A

Question 2

A **B1**

Answer: A

Question 3

(a) 3 / 33, oe **M1**

(a) awrt 0.09 cao **A1**

(a) Answer: Approximately 0.09.

(b) a mechanical disadvantage (a ratio below 1) **B1**

(b) because the effort arm is much shorter than the load arm, so more effort force is needed than the size of the load being moved, oe **B1**

(b) Answer: A mechanical disadvantage, because a ratio below 1 means the effort arm is much shorter than the load arm, so more effort force is needed than the load being moved.

(c) the small mechanical advantage means a small, fast contraction of the triceps close to the elbow produces a much larger and faster movement at the hand, oe **B1**

(c) this large range and high speed of movement at the hand is exactly what is needed to release the ball at high velocity, which is the fast bowler's goal, oe **B1**

(c) Answer: The small mechanical advantage means a small, fast contraction of the triceps close to the elbow produces a much larger and faster movement at the hand, which is exactly what a fast bowler needs to release the ball at high velocity.

Question 4

third class lever **B1**

the quadriceps (effort) inserts on the tibia close to the knee joint (fulcrum), between the fulcrum and the foot/ball (load), oe **B1**

Answer: Third class lever, because the quadriceps (effort) pulls on the tibia close to the knee (fulcrum), which lies between the fulcrum and the foot/ball (load).

Question 5

third class levers have a mechanical advantage below 1 (effort arm shorter than load arm), oe **B1**

this means the muscle must produce more force than the size of the load itself, so a very heavy load places a large strain on the muscle (and the joint), limiting the maximum load that can safely be moved this way, oe **B1**

Answer: Because third class levers have a mechanical advantage below 1, the muscle has to produce more force than the load itself, which places a large strain on the muscle and joint and limits how heavy a load can safely be moved this way.

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